GUNSHOT WOUND OF THE PANCREAS.

REPORT OF CASE, AND REVIEW OF LITERATURE.

BY F. GREGORY CONNELL, M.D.,

OF SALIDA, COLORADO,

Attending Surgeon, Denver and Rio Grande Railroad Hospital; Consulting Surgeon, St. Vincent's Hospital, Leadville.

Synopsis of Case.—T. R., aged twenty-one years, an American, miner, was shot in the abdomen, during a struggle for the possession of a .32-caliber revolver, at about 4 P.M., on December 13, 1901. He arrived at St. Vincent's Hospital, Leadville, two hours after the accident. Examination revealed a gunshot wound on the right side, midway between the axillary and mammillary lines, at about the seventh costal cartilage. Pulse, 100; temperature, 99° F., and respirations, 20.

He complained of intense colicky pain in the abdomen, chiefly in the region of the umbilicus. The entire abdomen was tender, but this was most pronounced above the umbilicus in the median line. There was present no distention, no marked rigidity of the abdominal muscles, the liver dulness was normal, and no evidence of fluid in the abdominal cavity. The patient was very restless, and continually rolled from side to side, crying for something to relieve the pain. During the examination, he vomited for the first time, and fresh red blood was found with the vomited matter. Laparotomy was performed one hour after admission to the hospital, three hours after the injury. Dr. J. A. Jeannotte assisted, and the late Dr. R. J. Gregerson administered the anæsthetic.

Exploration disclosed a through-and-through wound of the right lobe of the liver and a perforating wound of the stomach at its lesser curvature. These wounds were closed by suture, the through-and-through suture of the stomach wall was re-enforced by a suture of the lesser omentum. Examination of the large and small gut, the kidney, and the spleen was negative. The abdomen was then closed without irrigation or drainage. Recovery from the anæsthetic and the shock of the operation was satisfactory.

The next day, the 14th, the highest temperature was 101.2° F.; pulse 120 to 130, and the respirations from 16 to 20. There was quite a little nausea, some vomiting, but no hæmatemesis; slept for a short time at frequent intervals. The condition on the 15th was similar to that of the previous day in all respects; the pulse was never below 120, and the temperature was 102° F., at the highest, in the afternoon. There was no vomiting nor nausea, and the rectal enemata were well retained. During the night, restlessness gradually became marked; the pulse very rapid, and the temperature in the rectum went up to 102° F.; respirations were about 30; he became unconscious, and was in a muttering delirium. Physical examination of the abdomen was negative; there was no evidence of peritonitis, nor of hæmorrhage. The temperature became subnormal before death, which took place at about 3 A.M. on the 16th, sixty hours after the shooting.

Partial autopsy, six hours after death. No signs of peritonitis. Upon separating the gastrohepatic omentum where it had been sutured over the wound of the stomach, the stitches of the stomach wound were plainly visible, and for one-eighth of an inch on each side of this line of suture the stomach wall was of a dark, slaty color; in marked contrast to the shiny peritoneum elsewhere. In the centre of the sulcus there was a thin layer of thick, viscid, grumous, slate-colored material. There was positively no attempt at union between the apposed serous surfaces of the stomach wall, but there had been no leakage of stomach contents, because the sutures held the inverted margins in position. There was a small amount of serosanguinolent fluid in the lesser peritoneal sac. The pancreas was badly damaged by the passage of the bullet, the track of which was plainly visible, to the left of the middle of the body of the organ. The lining of this opening through the pancreas was dark in color, soft, and necrotic; surrounding this narrow zone of necrosis the pancreatic tissue was hard and mottled with red. The bullet was removed from the retroperitoneal tissues to the left of the second lumbar vertebra. There was no necrosis of the tissues that surrounded the bullet. The wounds of the liver were normal, as was also the laparotomy incision. (Figs. 1 and 2.)

This case is instructive from more than one point of view, for instance: A. The failure to detect a serious lesion of an

important organ intimately associated with the injured viscera. B. The condition of the stomach wound. C. The treatment.

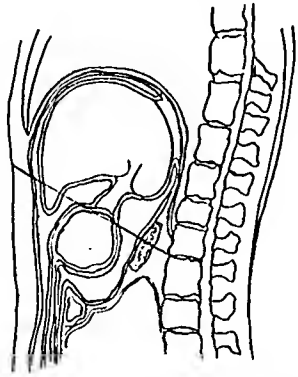

FIG. 1.—Anterior posterior direction of bullet track.

A. As to the frequency with which this oversight has taken place, we may quote from Mikulicz:[1] "We often find cases reported where wounds of the stomach or intestine having

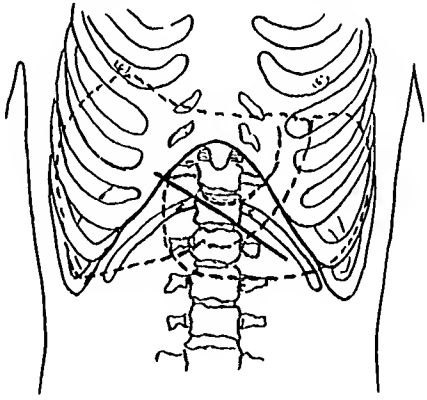

FIG. 2.—Lateral obliquity of bullet track.

been sutured, death has occurred from an undetected wound of the pancreas."

As to why this should be true, there are a number of explanations which might be advanced, such as:

(*a*) The prevailing opinion that the pancreas is rarely, if ever, injured, and that, if so, the wound is almost invariably fatal. Boeckel,[2] for example, in discussing Ceccherelli's paper at the International Congress of Medicine in 1900, said, "Les blessures du pancréas sont généralement mortelles d'emblée." And Michaux,[3] in the same discussion, concludes, "Que les ruptures du pancréas sont au-dessus des ressources de l'art." And from the *Philadelphia Medical Journal*,[4] in an editorial, "Wound of the pancreas which is usually immediately fatal."

(*b*) Without doubt, Mikulicz[5] explains a very frequent cause in saying, "When the abdomen is opened in such cases, the accompanying injuries of the surrounding parts almost always demand such attention that the lesion of the pancreas is easily overlooked."

(*c*) But perhaps the most important cause is the anatomical position of the organ and the consequent difficulty of a thorough examination.

All of these points tend towards a neglect of this organ in cases of traumatism of the upper abdomen.

There are five routes mentioned by Park[6] by means of which the pancreas may be approached; of these, three may be applicable for examination, *i.e.*, (1) above the stomach, through the lesser or gastrohepatic omentum; (2) below the stomach, through the greater or gastrocolic omentum; (3) behind the stomach and colon, through the transverse mesocolon.

B. Condition of the stomach wound. Non-union of approximated serous surfaces may be due to various causative factors, but when this condition is found in conjunction with a wound of the pancreas it does seem rational to assume that the non-union has been caused, in part at least, by the action of the pancreatic juice upon the tissues at the site of the imperfect healing. The properties of the pancreatic juice, in some particulars, are still more or less obscure. While its action upon food substances within the intestinal canal is well recognized and definite, its action upon different structures of the living body is still more or less vague and indistinct. We

may consider its action upon (1) epidermis, (2) deeper structure, (3) granulation tissue, (4) peritoneum.

1. The effect of the pancreatic juice upon the skin has been noted in many cases of high intestinal fistulæ, in drained pancreatic cysts, and, experimentally, in pancreatic fistulæ. Almost invariably with all of these conditions there results an irritation, and, finally, a destruction of the epidermis, which is in prolonged contact with the fluid discharged from the fistulous opening. This effect is supposed to be due to the digestive action of the pancreatic juice.

2. The digestion is confined to the superficial layers of the skin, the epidermis alone is destroyed in this manner, the destruction of cells does not extend deeply but peripherally. The cutis vera and the subcutaneous structures seem to be able to resist the digestive action of the pancreatic juice. The deeper structures may show signs of irritation or of inflammation, but whether this is due to the irritation of the pancreatic juice, or an irritation subsequent to a deprivation of its normal covering, the epidermis, cannot be definitely stated; but these underlying structures are not digested and removed as are the cells of the cuticle.

3. Granulation tissue is usually formed after the superficial layers have been removed; and it has been found that the cells of this tissue are able to withstand the presence and the action of the escaped pancreatic juice. One explanation for this difference in behavior of the pancreatic secretion on the epidermis and upon the true skin and granulation tissue may be found in a possible absorption of the digestive juice by the vascular tissues after the superficial layers have been removed. Or perhaps a better in a theory advanced by H. W. Cushing,[7] of Boston, to the effect that the epidermis is composed of cells with practically no vitality, hence the digestion, which is not possible in living, vascular, deeper cells, peritoneum, or granulation tissue.

4. On account of the marked effect of the pancreatic juice upon the skin, it was naturally to be supposed that this same fluid would cause a reaction greater, or at least equal,

upon the much more sensitive peritoneum. But early in the era of pancreatic experimentation, Claude Bernard,[8] in 1855, found that when the pancreatic juice escaped into the peritoneal cavity there was practically no peritonitis as a result.

Heidenhain subsequently confirmed this observation, and is quoted by Senn[9] as follows: "The animals do not suffer from this circumstance, as the duct is regenerated in spite of the wounded surface being bathed in the secretion. Nevertheless, it is difficult to explain this. Why do not the wounded and suppurating tissues undergo digestion by the pancreatic juices?" And Senn,[10] in 1886, also verified these findings.

After the experimental establishment of internal pancreatic fistulæ, he concluded that, "Extravasation of fresh normal pancreatic juice into the peritoneal cavity does not produce peritonitis, but is promptly removed by absorption." In 1888, Martinotti,[11] after the experimental removal of the pancreas, arrived at the same conclusion. And in 1897 Flexner[12] said, "The secretion of the pancreas *may* enter the peritoneal cavity without setting up a diffuse inflammation."

Cushing,[13] in 1898, said, "It is hard to understand why the fluid digests epidermis and not granulation tissue or peritoneum."

Ceccherelli,[14] in 1900, said, relative to this point, that his experience was in accord with that of Senn and Martinotti. He further stated that the pancreatic juice cannot cause peritonitis if it is pure, as it is rapidly absorbed. But if altered it may produce septic phenomena.

In 1903, at the Congress of American Physicians and Surgeons, Mikulicz[15] said, "The point as to whether or not this leakage is injurious was only recently definitely settled. After the experiments and experiences of recent years, we can no longer doubt that such leakage is indeed harmful. The experimental studies of Williams, Flexner, Biondi, Katz and Winkler, and others, show clearly that injuries of the pancreas, through which the vitality of a part of the organ is impaired, and the flow of pancreatic juice towards the pancreatic duct is hindered or ceases entirely, seriously affect the peritoneum

and the neighboring tissues." . . . "If we ask ourselves whether the secretion from the injured pancreas leaking into the abdominal cavity can of itself so damage the peritoneum that death from this cause alone may result, we must surely admit that this is a possibility, as shown by a number of experiments and clinical observations of accidental injuries in man." . . . "It seems, moreover, that the secretion from the injured or also inflamed panereas without bacterial invasion can cause a variety of aseptie peritonitis." . . . "Blood and panereatie secretion ooze into the peritoneal cavity, preventing the formation of peritoneal adhesions."

The above is quoted at length, for it is a statement of the generally accepted facts to-day, and was stated by, perhaps, the foremost authority upon the subject at this time, before the representative physicians and surgeons of America. And while directly opposite to the previous teachings, it is what might be expected from a theoretical stand-point.

The condition of the stomach wall in the case under consideration may possibly be explained, in the light of the most recent investigations, somewhat as follows:

That the pancreatic fluid escaped into the peritoneal cavity cannot be doubted. Its presence did not cause a general peritonitis. The site of the gastrorrhaphy and the lining of the track of the bullet through the pancreas were superficially necrotic. There must have been some reason why this localized necrosis took place while the rest of the abdominal cavity remained practically normal.

The location of these destructive changes would lead to the belief that possibly the digestive juices of the stomach or intestine might have acted as predisposing or aiding factors. The pancreatic juice must have passed over, and had no appreciable effect upon, a large portion of the serous covering of the stomach. No destructive action was noted till the site of the perforation was reached; at this point the gastric juice and the fluid from the injured pancreas might have combined with a resulting destruction of tissue. The suture of the lesser omentum over the stitches in the stomach proper seems to have been no protection.

The necrosis along the path of the bullet in the pancreas is not so difficult to explain. The altered pancreatic juice and blood alone might have been able to produce the change; or infective matter, or stimulants to the pancreatic ferments, might easily have ascended to the wound by means of the common duct and the duct of Wirsung. The fact that the cavity in which the bullet rested was not necrotic might be explained by the presence of some obstruction in the track which prevented the fluid from gravitating into this final lodgement of the missile. The normal condition of the wounds of the liver and that of the abdominal wall may be explained by the dorsal position of the patient and the lack of contact with the fluid from the injured pancreas.

On the other hand, it may be that the intestinal or gastric secretions had nothing whatever to do with the change, and that the mere suturing, or the passage of the bullet, caused sufficient trauma to prevent the tissues from resisting or counteracting the action from the damaged pancreas. In 1898, Williams [16] suspected that the pancreatic juice may be possessed of irritating properties which make the tissues in contact with it extremely liable to infection. And Mikulicz [17] said, "But if the vitality of the peritoneum has been impaired by the action of the pancreatic secretion, then a limited number of bacteria are sufficient to cause peritonitis."

In an attempt to study this question, the writer made various experiments on dogs, in which, to the establishment of an internal pancreatic fistula, there was added traumatism of the adjacent peritoneum, and in some instances the endothelial layer was entirely removed. But in none of these cases was there any apparent effect of the pancreatic juice upon the injured or denuded areas. In others the pancreas was injured, so that, without doubt, its secretion escaped into the peritoneum, and then a suture, or rather a seton, was passed into the lumen of the adjoining stomach or duodenum and tied with a large knot in the peritoneal cavity. The results were various, but in no case was there any localized peritonitis or gangrene comparable to that in the case reported.

Popelsky[18] has proved to his satisfaction that the pancreatic juice alone cannot digest proteids; but when brought in contact with intestinal secretion, however, its protypdin is converted into trypsin, and the latter successfully attacks proteids. This would seem to be questionable when it is remembered that the fluid from a retention cyst of the pancreas, which certainly does not communicate with the duodenum, when drained has been known to digest the epidermis of the skin adjacent to its place of exit.

Pawlow[19] discovered a new enzyme in the gastric secretion, a specific ferment called "chymaze," which does not digest food, but which accelerates the action of the ferments of the pancreatic secretion.

Pawlow and Chepowalinkoff[20] have shown that the pancreatic activity may be increased by the addition of an extract of intestinal mucosa or succus entericus. This is accomplished by a body called "enterokinase." The terms enterokinase and chymaze seem to be used interchangeably in the literature. It may have been the presence of this chymaze or enterokinase at the wounds that stimulated the pancreatic secretion to a greater activity which caused the necrosis; and its absence from the adjacent peritoneum may account for the lack of action by the same fluid.

C. Treatment. The most important element in the treatment is the finding of the condition. And in order that it may not be overlooked, it must be borne in mind that the pancreas may possibly be damaged in each and every case of injury of the upper abdomen. Examination with such a possibility in mind will but rarely fail to detect the lesion, if present. When a lesion of the pancreas is found in a case of gunshot wound, the treatment will consist of suture or drainage.

Suture alone has but little in favor of it, on account of the deep position of the organ; sutures are properly placed only with great difficulty; the structure of the pancreas is not suitable for the holding of stitches, and even with careful suturing the coaptation is apt to be faulty, with a consequent leakage.

On the clinical side there is recorded but one case in which this line of treatment, *i.e.*, suture alone, was employed. And this made an uneventful recovery. When suture of the damaged viscus is possible and practicable, without prolonging the operation too long, it should be done, and the drain brought to the site of the suture.

Drainage has been employed in the great majority of these cases; and it is a noteworthy fact that in the two instances where a localized destruction of tissue occurred drainage was not instituted.

Leakage of fluid from the damaged organ is almost certain to occur, either into the retroperitoneal structures or into the free peritoneal cavity. And as it is certain that this fluid will do less harm outside of the body than in either of these locations, it is therefore advisable to drain each and every case, and even in suspected cases, if the condition of the pancreas has not been definitely determined upon. Tubular and gauze drains have each been employed, but the best drainage is undoubtedly obtained by a combination of gauze and a tube.

In all of the reported cases except Jepson's, the drainage has been effected through the anterior abdominal wound, but as a much more perfect drainage can be maintained by means of a posterior opening (R. Park),[21] it is therefore to be recommended as an additional safeguard in all cases of pancreatic injury. Case XVIII (Jepson) must be looked upon as a model for treatment of gunshot wound of pancreas.

The following cases are all that have been reported in available literature to date, and for fifteen of these we are indebted to the very able article by Borchardt.[22]

CASE I.—OTIS. Medical and Surgical History of War of the Rebellion, Part II, Vol. ii, page 159. Wound of entrance, six inches to the left of the spinal column, below the eighth rib. Wound of exit, none. Symptoms, pulse good, slightly irritable. No marked symptoms for two weeks, then hæmorrhage from the wound, with hæmaturia repeated. Result, death one month after the receipt of the injury. Course of the bullet, spleen and pancreas.

CASE II.—IMD. Wound of entrance, one line to the left and below ensiform. Wound of exit, just above the crest of the ilium. Symptoms,

pulse quick and feeble, abdomen distended and tympanitic. Result, while feeling much better, death occurred suddenly on the fifteenth day. Course of bullet, inferior curvature of the stomach, about the middle of the pancreas. Omentum was in a state of partial decomposition, with general peritonitis.

Case III.—Otis. Wound of entrance, below spine of left scapula, an inch from shoulder-joint. Wound of exit, none. Symptoms, emphysema, pronounced jaundice on eighth day. On the ninth day, profuse hæmorrhage from the nose and mouth. Pulse weak and thready. Result, death on twelfth day. Course of bullet, scapula, fifth rib, left lung, lower lobe, diaphragm, liver, left lobe, and pancreas.

Case IV.—Sanitas. Report of German Army in War, 1870–1871. Wound of entrance, left of body of eighth vertebra. Wound of exit, left of navel. Symptoms, coughing of blood, suppuration of the posterior wound. Result, death on the twenty-fifth day. Course of bullet, fracture of the eighth rib, spleen, and pancreas.

Case V.—Niemann, Mayer. Wound of entrance, beneath ensiform process. Wound of exit, between second and third false ribs near vertebra. Result, immediate death. Course of bullet, heart, diaphragm, liver, and pancreas.

Case VI.—Bertram. Inaug. Diss., Jena, 1893. Wound of entrance, first, between navel and ensiform; second, sixth intercostal space, left mammillary line. Wound of exit, none. Symptoms, hæmatemesis, hæmoptysis, hæmaturia, collapse. Result, death. Course of bullet, first, stomach and head of the pancreas; second, diaphragm, twelfth rib, spleen, and left kidney.

Case VII.—Von Bramann, Weimuth. Archiv f. klin. Chir., Vol. lx, 1899, 1900, page 482. Wound of entrance, under angle of left eleventh rib. Wound of exit, none. Symptoms, brought to hospital three hours after injury; general findings good. Six hours later, hæmatemesis twice. Operation, nine hours after injury. Course of bullet, through stomach, mucous membrane prolapsed, bullet found in pancreas. No stomach contents in abdomen, but a teaspoonful of blood. Treatment, suture of stomach wound, site of suture tamponed, wound of pancreas likewise tamponed. Result, recovery.

Case VIII.—Ibid. Wound of entrance, under costal arch midway between sternum and left mammillary line. Wound of exit, none. Symptoms, brought to hospital six hours after injury, one-half hour later hæmatemesis. Operation, eight hours after accident. Course of bullet, through the stomach and into the pancreas. Some stomach contents in abdominal cavity. Treatment, suture of the stomach wound, surrounding the same with gauze. Pancreatic injury also packed with gauze. Result, recovery.

Case IX.—E. Hahn. Deut. Zeit. f. Chir., Band lviii, 1900, 1901. Wound of entrance, left of median line at the height of the seventh and eighth costal cartilage. Wound of exit, bullet found under the skin, at about a level with the left kidney. Symptoms, pulse small and rapid; belching of gas but no vomiting; marked anæmia and prostration; dul-

ness in the left half of the abdomen. Operation, laparotomy for hæmorrhage shortly after admission, which was one-half hour after accident. Course of bullet, through left lobe of liver, through lesser omentum, through the transverse mesocolon into pancreas; stomach uninjured. Treatment, cleaning of the peritoneal cavity, and packing the track of the bullet with gauze. One strip of gauze in the anterior wound of the liver; a second in the posterior wound of the liver; a third in the opening of the gastrohepatic omentum, and another in the opening of the mesocolon, and into the retroperitoneal effusion of blood. Result, recovery.

Case X.—G. Nini. Cent. f. Chir., No. 41, 1901, page 1024. Wound of entrance, right of second lumbar vertebra. Wound of exit, right epigastric region, between mammillary and parasternal lines. Symptoms, ran 500 yards after the receipt of injury. Brought to hospital collapsed, almost unconscious; pulse thready; abdomen painful and tympanitic. Operation, opening of the peritoneum was followed by the escape of blood and gas, eight wounds of gut were sutured. In making toilet, found blood oozing from between the stomach and the transverse colon; a transverse incision from umbilicus to the right axillary line, and tearing through the gastrocolic omentum, revealed a wound of the pancreas at the junction of its head and body. Course of bullet, pancreas, six wounds of small intestine, one wound of hepatic flexure of colon. Treatment, two deep sutures of the pancreas, no drainage. Result, recovery.

Case XI.—M. Borchardt. Berl. klin. Woch., January, 1904, No. 3. Wound of entrance, epigastrium, left of median line. Wound of exit, none. Symptoms, extreme nervousness; marked pallor; pulse good; vomited blood. Operation, four and one-half hours after accident, upon opening the peritoneum, blood shot out, and the pulse disappeared. Course of bullet, left lobe of liver, portal vein, tail of the pancreas, vena lienalis were torn and bleeding. Treatment, suture and drainage (gauze packing). Result, recovery.

Case XII.—Von Bramann, Weimuth. Ibid. Wound of entrance, one centimetre to the left of the end of the ensiform cartilage. Wound of exit, none. Symptoms, one-half hour after the accident, vomited three times; no blood; came to the clinic next morning. Patient strong but pale; pulse strong but small. Slight tympanites; dulness over the left lobe of the lung, with some dyspnœa. Dulness likewise in the epigastrium and the left hypochondrium. During the last few hours before operation postoperative symptoms. Death occurred on the ninth day. Autopsy laparotomy, twenty hours after the accident. Liver bleeding freely, about one and one-half litres of blood in pelvis. Gastro-intestinal canal negative. Course of bullet, through liver and lesser omentum, and disappeared in the body of the pancreas. Treatment, wounds of liver and pancreas tamponed with iodoform gauze. Result, death thirty-three hours after injury.

Case XIII.—M. Simmonds. Mün. med. Woch., 1898, No. 6, page 169. Wounds of entrance and exit not given. Symptoms, those of internal, peritoneal, hæmorrhage. Operation, laparotomy two hours after the injury. The source of the bleeding was not discovered, and, as it stopped

spontaneously, the abdomen was closed. Result, patient went into collapse, and died thirty-six hours after the operation. Course of the bullet, as shown by the autopsy, was through the pancreas; the vena lienalis were opened. Fat necrosis was noted.

CASE XIV.—MANN and MYNTER. American Medicine, October 19, 1901. Wound of entrance, midway on a line from left nipple to umbilicus. Wound of exit, none. Symptoms, pulse getting weaker, with a perforating wound of the peritoneal cavity. Operation, one and one-half hours after the injury. Course of bullet, anterior wall of stomach, posterior wall of same; palpation of the deeper structures behind the stomach revealed no trace of the bullet or its track. Treatment, both wounds of the stomach were sutured and the abdomen closed without drainage. Result, with the exception of a gradually weakening pulse, there were no marked postoperative symptoms. Death occurred on the ninth day. Autopsy revealed additional injuries to the pancreas and left kidney, also extensive necrosis of the pancreas and the gastric wall in the neighborhood of both wounds.

CASE XV.—KORTE. Verhand. der Freien Chir., Verein, Band xiii, p. 87. Wound of entrance, below the costal arch, to the right of the middle line. Wound of exit, none. Operation, laparotomy, eight hours after the injury; much blood and intestinal contents in the abdominal cavity. Course of bullet, through the colon, the mesocolon, into the head of the pancreas; a loop of the small intestine was shot through in many places. Treatment, resection of the small intestine was necessary. Result, death a few hours later. Autopsy, fat necrosis was present.

CASE XVI.—K. G. SLAVSKY. Roussky Vratch, July 31, 1904, Abstract. New York and Philadelphia Medical Journal, September 17, 1904, page 565. Wounds of entrance and exit not given. Symptoms, intense shooting pain in legs and thighs, showing involvement of lumbar plexus. Operation, laparotomy five hours later. Course of bullet, through liver, stomach, lesser omentum, and pancreas. Bullet was not found. Treatment, wounds carefully closed with Lembert sutures (drainage not mentioned in abstract). Result, recovery.

CASE XVII.—CONNELL. (Case reported in this article.) Wound of entrance, below the fourth costal cartilage, right side. Wound of exit, absent. Symptoms, two hours after accident, pulse, 100; temperature, 99° F., and respiration, 20. Complained of intense colicky pains in the region of the umbilicus. Very restless; hæmatemesis. Operation, laparotomy three hours after injury. Course of bullet, through liver, through stomach at the lesser curvature, farther course not found. Treatment, suture of the stomach wound, and suture of the lesser omentum over the line of union. Liver wounds packed and then sutured. Abdomen closed without drainage. Result, death sixty hours after accident. Autopsy showed wound of the pancreas a little to the left of the middle; track of bullet through pancreas necrotic; site of suture of the stomach likewise necrotic; liver and abdominal wounds normal; no peritonitis.

CASE XVIII.—W. JEPSON. Personal communication. Wound of entrance, left fifth intercostal space, one and one-half inches from costal margin. Wound of exit, none, but bullet could be palpated above crest

of ilium at outer side of quadratus lumborum muscle. Symptoms, was seen by operator seven hours after accident. Shock not marked; child walked upstairs after the injury. Vomited blood and mucus; stomach was empty. Temperature, 97.4° F.; pulse, 108; respirations, 24. Pain not extreme. Operation, nine hours after receipt of injury. Incision in left linea semilunaris extending four inches from costal margin; this was joined by a transverse incision three inches long into the iliocostal space. Course of bullet, through diaphragm, anterior, superior, and posterior inferior walls of the stomach, mesocolon, and pancreas. It was thought that the duct of the latter organ was not injured. Treatment, diaphragm closed; both wounds of stomach closed by double purse-string sutures. Pancreas sutured with fine silk; drainage-tube fastened with catgut at site of pancreatic sutures; this tube was brought out posteriorly after incising the skin and dilating the track of the bullet; the tube was surrounded with gauze. The omentum was attached by catgut at the site of the suturing. The posterior gastric wound and the superior wound of the pancreas were provided for by a cigarette drain; after the peritoneal toilet was completed, this drain was brought out below the ribs at the outer border of the left quadratus lumborum muscle. The interior abdominal wound was closed without drainage. Result, recovery.

Case XIX.—Otis. Ibid. (Mikulicz, in his address before the American Congress of Physicians and Surgeons, mentions one case of recovery after operation for gunshot wound of the pancreas which he credits to Otis. After searching the literature on the subject, this is the only one that I have been able to find that might be the case. It is inserted last, as its belonging with the other cases might be rationally questioned. The case is as follows.) Wound of entrance, right side below ribs. Wound of exit, on the left side. Two days after injury, while straining at stool, a hernia of the pancreas, size of hen's egg, presented. No special symptoms supervened. Operation, silver wire passed around the pedicle, and tightened every day for a week, till it became very small, and was then snipped off with scissors. Result, left hospital in a month, and was still well two months after.

Since the above was written the following case has been noted.

Case XX.—A. Becker. (Zent. f. Chir., 1905, No. 5.) Wound of entrance, between eighth and ninth left costal cartilage. Wound of exit not mentioned. Operation, laparotomy, one hour after injury, disclosed a grazing wound of the stomach, without perforation into the lumen of this viscus. A large hole in the tail of the pancreas. The pleura was torn. Treatment, suture and gauze packing. Result, recovery, with pancreatic fistula, which finally closed.

In reviewing these cases there will be found 20 cases with 11 deaths and 9 recoveries; 6 cases not operated upon, 6 died. Considering No. XIX as a non-operative case leaves 7 non-

operative cases, with 6 deaths and 1 recovery, 12 operated cases with 5 deaths and 7 recoveries. In three of these 12 cases the injury of the pancreas was unsuspected or not found, all of which resulted fatally, leaving 9 cases operated for gunshot wound of the pancreas, of which 2 died and 7 recovered.

As to the operative procedure.

In 7 cases no operation was performed, of which 6 died and 1 recovered.

In 3 cases laparotomy was performed, but nothing was done to the pancreas; abdomen was not drained, 3 died.

Drainage of the pancreas, 4 times, 1 died and 3 recovered.

Suture of the pancreas, no drainage, in 1 case with 1 recovery; with drainage, 3 times, with 3 recoveries; with drainage not mentioned, 1 with a recovery.

As regards the other viscera injured there were:

Stomach, 8 times with 4 recoveries and 4 deaths.

Liver, 7 times with 3 recoveries and 4 deaths.

Lesser omentum, 4 times with 2 recoveries and 2 deaths.

(In two instances was the lesser omentum injured without injury to the stomach.)

Diaphragm, 3 times with 1 recovery and 2 deaths.

Spleen, 2 times with no recoveries and 2 deaths.

Small intestine, 2 times with 1 recovery and 1 death.

Large intestine, 2 times with 1 recovery and 1 death.

Lung, 1 time with no recoveries and 1 death.

Kidney, 1 time with no recoveries and 1 death.

Heart, 1 time with no recovery and 1 death.

Portal vein, 1 time with 1 recovery and no death.

Fat necrosis was noted on only two occasions at autopsy, and not at all at the time of the operation.

Death occurred at variable times after the receipt of the injury.

In the 6 non-operated cases, 30 days, 15 days, 12 days, 25 days, immediately, immediately.

In the 5 deaths following operation:

Operation 20 hours after the accident, with death occurring 33 hours after the injury; 2 hours after accident, death

38 hours after; 1½ hours after accident, death on the ninth day; 8 hours after accident, death a few hours later; 3 hours after accident, death 60 hours after.

In the 7 recoveries after operation, the operation was performed 9, 8, 1, unknown, 4½, 5, 9 hours after the injury.

The wound of entrance in 6 cases was in the posterior abdominal wall, and in the other 13 it was in the anterior wall.

A *résumé* of the symptoms in these 20 cases leads to the conclusion that there are no pathognomonic, or even suggestive, symptoms of injury of the pancreas in gunshot wounds of the abdomen. The probable course of the bullet is the chief guide. In wounds of the lesser omentum and the posterior wall of the stomach, especially, injury of the pancreas must be excluded before the abdomen is closed.

BIBLIOGRAPHY.

[1] Mikulicz. Transactions of Congress of American Physicians and Surgeons, 1903, page 63.
[2] Boeckel. Report of XIII Cong. Internat. de Méd. et de Chir., Rev. de Gyn. et de Chir., Abd., April, 1900.
[3] Michaux. Ibid.
[4] Philadelphia Medical Journal, September 14, 1901.
[5] Mikulicz. L. c., page 56.
[6] Park. Medical News, March 15, 1902.
[7] Cushing. Annals of Surgery, Vol. xxviii, 1898, page 512.
[8] Bernard. Leçons de Phys. Appliq. a la Médecin, 1855, Paris.
[9] Senn. Surgery of the Pancreas, page 53.
[10] Senn. Ibid., page 128.
[11] Martinotti. Giorn. Della R. Acad. d. Medicine, 1888, No. 7.
[12] Flexner. Journal Experimental Medicine, 1897, Vol. ii.
[13] Cushing. L. c.
[14] Ceccherelli. Rev. de Gyn. et de Chir., Abd., April, 1900.
[15] Mikulicz. L. c., pages 58, 59, 60.
[16] Williams. Journal Experimental Medicine, 1898, Vol. iii.
[17] Mikulicz. L. c., page 60.
[18] Popelsky. Roussky Vratch, April 19, 1903; American Medicine, July 25, 1903, page 161.
[19] Hemmeter. Progressive Medicine, December, 1903.
[20] Borissof. International Clinics, Vol. ii, 12th Series.
[21] Park. Annals of Surgery, August, 1902.
[22] Borchardt. Berliner klin. Woch., January, 1904, Nos. 3 and 4.